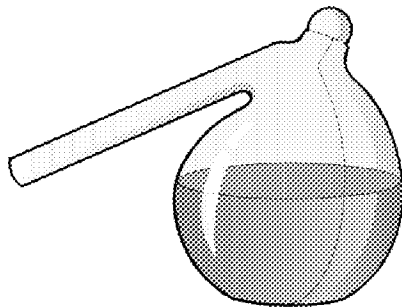


Module 4

CHEMICAL SAFETY



Introduction

What You Need to Know

- **Regulations**
- **Principles of working with hazardous chemicals**
- **Standard lab practices**
- **Specific chemical information**



4.1



Introduction

Regulations

- **OSHA Regulations**
 - *Hazard Communication Standard*
 - *Lab Standard*
 - *PPE Standard*
 - *Air Contaminant Standards*
- **EPA, DOT, NRC**
 - *Resource Conservation & Recovery Act*

4.1

Introduction

Dr. Karen Wetterhahn (1948-1997)
Dartmouth College

- Dimethylmercury
- TLV = 0.01 mg/M³
(0.001 ppm)
- Potent neurotoxin
- Poisoning difficult to treat
- DMM experiments
- Latex gloves
- NO protection
- Poisoning - 1st symptoms 3 mos., severe 5 mos.
- Died 10 months

4.1

Principles

General Rules

- **Minimize all chemical exposures**
- **Know your chemicals & inventory**
- **Plan ahead**
- **Never underestimate the risks**
- **Prepare for emergencies**



4.2

Principles

General Rules

- **Apply good work practices**
- **Use PPE**
- **Apply good housekeeping practices**
- **Use ventilation & engineering controls to prevent/eliminate aerosol production**



4.2



Principles

General Rules

- **Minimize quantities used, ordered, stored**
 - *Smaller amounts = smaller risks*
 - *Reduces storage, waste disposal*
- **Use less toxic alternatives**

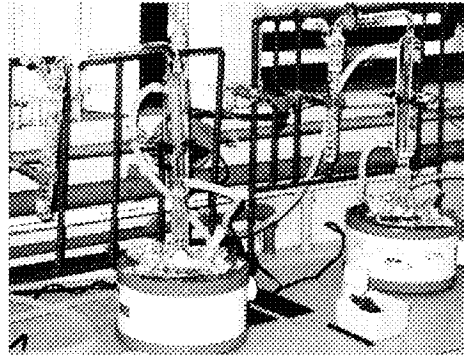
4.2

Principles

General Rules

Know the Hazard

- **Physical**
 - *Explosive*
 - *Flammable*
 - *Reactive*
- **Health**
 - *Toxic*
 - *Corrosive*



4.2

Principles

General Rules

Know Route of Exposure

- ***Contact***
 - ***Skin***
 - ***Eyes***
 - ***Mouth***
- ***Ingestion***
- ***Inhalation***
- ***Puncture/Cut***



4.2

Principles

General Rules

Protect Yourself

- Information
 - Labels
 - MSDS
 - Manufacturers fact sheets
 - Review work procedures



4.2



Principles

General Rules

MSDS (Material Safety Data Sheet)

- ***Chemical ID #***
- ***Physical hazards***
- ***Physical/chemical characteristics***
- ***Reactivity***
- ***Health hazards***
- ***Controls - PPE, hygiene, engineering***
- ***Emergency response***

4.2



Principles

General Rules

Practice good housekeeping

- *Clean up after each experiment*
- *Don't store materials on work surfaces*
- *Keep aisles clear*
- *Keep chemicals in storage cabinets*
- *Purge work areas of unnecessary or unused equipment, supplies, chemicals*

4.2



Standard Laboratory Practices

General

- 1. Access to the lab is restricted**
- 2. Signs identifying hazards and responsible personnel posted on all access doors**
- 3. PPE (lab coat/apron, eye wear, gloves) are required for ALL personnel and visitors in areas where chemicals are used and stored.**
- 4. Eating, drinking, applying cosmetics, and food are not permitted in lab areas.**

4.3



Standard Laboratory Practices

General

- 5. Mouth pipetting is prohibited**
- 6. All chemicals are stored according to “compatibilities”**
- 7. Chemical inventories are maintained and accessible**
- 8. All chemical containers are labeled and dated after opening**

4.3



Standard Laboratory Practices

General

- 9. Compressed gas cylinders are secured at all times**
- 10. Chemical fume hoods, splash shields and/or respirators are used to prevent inhalation exposure**
- 11. Outdated and obsolete chemicals are disposed of annually**
- 12. Wastes are properly packaged and labeled for disposal**

4.3



Standard Laboratory Practices

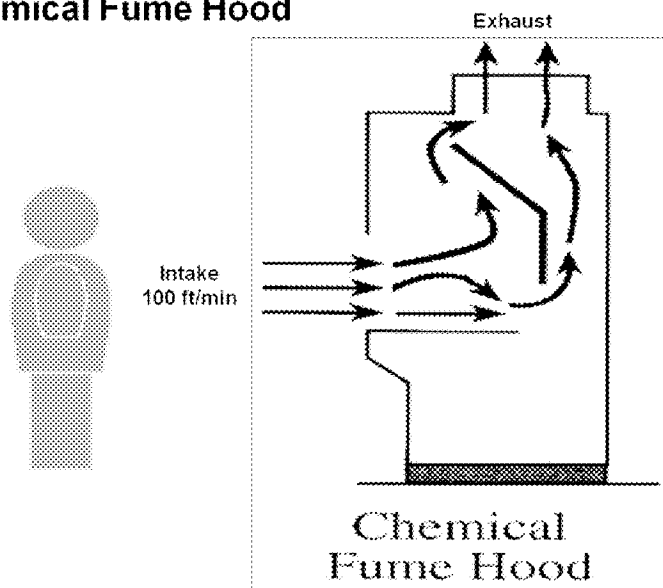
General

- 13. Spills are promptly cleaned up and area decontaminated**
- 14. Work surfaces are cleaned regularly and kept uncluttered**
- 15. Emergency equipment is checked regularly for operation and kept free from obstructions**
- 16. All chemical laboratories have a lab specific chemical safety manual**

4.3

Standard Laboratory Practices

Chemical Fume Hood



4.3

Standard Laboratory Practices

Chemical Fume Hoods

Proper usage:

- ***Ensure hood certification annually***
- ***Ensure hood working before use***
- ***Work at least 6 inches inside***
- ***Minimize storage***



4.3



Standard Laboratory Practices

Chemical Fume Hoods

Proper usage:

- ***Place all materials into hood before beginning work***
- ***Limit arm movements; move straight in and straight out***
- ***Keep sash at certification point or lower***
- ***Ensure slot at back of hood is not obstructed***
- ***Elevate equipment above hood floor***

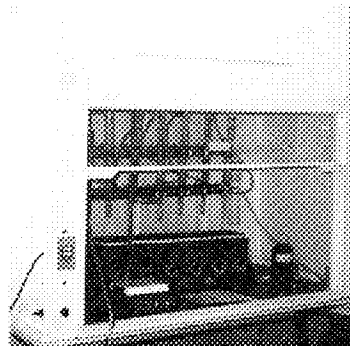
4.3

Standard Laboratory Practices

Chemical Fume Hoods

Proper usage:

- ***Don't block air foil***
- ***Run cables under air foil***
- ***Don't put large equipment in hood***
- ***Do not turn off hood when chemicals are inside***



4.3



Standard Laboratory Practices

Chemical Fume Hood

Safe Practices

- ***Do Not use fume hoods to store chemicals***
- ***Check with RSO before using radionuclides***
- ***Limit activity in area when working at hood***
- ***Always lower glass shield to certification mark or lower***
- ***Perform work slowly - move straight in and out***

4.3

Standard Laboratory Practices

Hazardous Chemicals

Flammables

- **Fire, explosion - *most dangerous & expensive* of accidents**
- **Reduce risk**
 - ***Minimize quantities***
 - ***Ventilation, fume hoods***
 - ***No Ignition sources***
 - ***Store in flammable cabinets, chemical safe refrigerators***

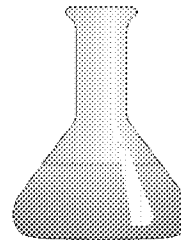
4.3

Standard Laboratory Practices

Hazardous Chemicals

Corrosives

- PPE for skin, eyes
- Emergency eye wash/shower
- Incompatibilities
- Storage
- Containment of spills



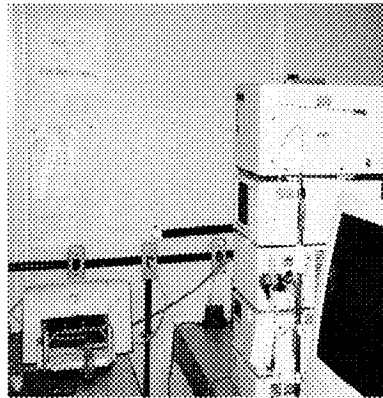
4.3

Standard Laboratory Practices

Hazardous Chemicals

Toxic Chemicals

- ***Know your chemicals***
- **Ventilation, fume hoods**
- **Contamination control**
- **PPE (specific)**
- **Minimize exposures**



4.3

Standard Laboratory Practices

Hazardous Chemicals

Highly Toxic Chemicals

- **Restricted access**
- **Experienced personnel**
- **Practice w/ non-hazardous chemical**
- **Contain**
 - ***Ventilation***
 - ***PPE***
 - ***Work practices***
 - ***Proper disposal***

4.3



Standard Laboratory Practices

Storage

- Reduce amount of chemical
- Segregate chemicals
- Label containers w/:
 - *Receipt date; opening date; user name*
- Know hazards of chemicals
- Know your inventory
- Discard chemicals on schedule

4.3

Standard Laboratory Practices

Storage

- **Avoid storing chemicals on top of cabinets**
- **Keep exits, passageways, floors free of chemical containers**
- **Avoid storing chemicals in hoods, or on bench tops**



4.3

Standard Laboratory Practices

Storage

- **Store odorous chemicals in ventilated cabinets**
- **Store highly toxic chemicals in secondary containers**
- **Secure highly toxic chemicals**

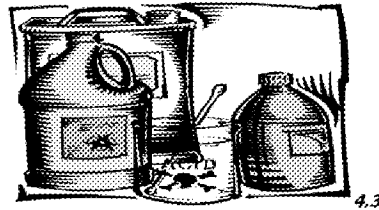


4.3

Standard Laboratory Practices

Storage

- Do not expose stored chemicals to:
 - *Heat*
 - *Direct sunlight*
- Do not generally store alphabetically
- Watch for & separate incompatibles



4.3



Standard Laboratory Practices

Storage

- **Separate into compatible groups**
 - *Then store alphabetically*
- **Store in appropriate cabinets**
 - *Flammables only in approved cabinets*
 - *Flammable in laboratory-safe refrigerators*
 - *Acids, bases, oxidizers in separate cabinets*

4.3

Standard Laboratory Practices

Storage

Flammables

- **Class 1A: extremely flammable**
 - *f.p. below 23°C/ b.p. below 38°C*
 - *diethyl ether, pentane, hydrogen*
- **Class 1B: ignites at normal temperature**
 - *f.p. below 23°C/b.p. at or above 38°C*
 - *Acetone, ethanol, toluene*
- **Class 1C: ignites when moderately heated**
 - *f.p. at or above 23°C and below 38°C*
 - *Styrene, xylene*

4.3



Standard Laboratory Practices

Storage

Flammables

- Many serious accidents w/ storage in domestic refrigerators (not lab safe)
- All refrigerators, freezers for the storage must be lab safe
- NFPA 45 Standards for Lab Refrigerators

4.3



Standard Laboratory Practices

Storage

Peroxide Formers

- Among most hazardous chemicals
- Form spontaneously
- Shock & heat sensitive
- Explosive hazard!!

4.3



Standard Laboratory Practices

Storage

Peroxide Formers

- **Date container**
 - *Upon receipt*
 - *At opening*
- **Discard all unopened**
 - *After 18 Months*
- **Never distill or concentrate**
- **Store in dark, cool place**

4.3



Standard Laboratory Practices

Storage

Peroxide Formers (most dangerous)

- **Discard 3 months after opening**
 - *Isopropyl ether*
 - *Divinylacetylene, butadiene*
 - *Vinylidene chloride, chloroprene, tetrafluoroethylene*
 - *Potassium metal*
 - *Sodium amide, potassium amide*

4.3



Standard Laboratory Practices

Storage

Peroxide Formers (most used)

- **Discard *12 months* after opening**
 - *Diethyl ether, tetrahydrofuran, dioxane, other ethers*
 - *Acetaldehyde, acrolein, acetal, other aldehydes & acetals*
 - *2-Propanol, 2-butanol, 2-pentanol, other secondary alcohols*
 - *Methyl isobutyl ketone*

4.3



Standard Laboratory Practices

Storage

Peroxide Formers (frequently used)

- **Discard 12 months after opening**
 - *Cumene, cyclohexene, dicyclopentadiene, alkenes*
 - *Acrylic acid, methyl methacrylate, acrylonitrile, other acrylics*
 - *Benzyl alcohol, 2-phenylethanol, tetralin, other benzylics*
 - *Decalin, methylcyclopentane, hydrocarbons w/ tertiary H's*

4.3



Standard Laboratory Practices

Storage

Incompatibles

- **React violently with each other to produce:**
 - *Explosion*
 - *Heat*
 - *Highly toxic or flammable products or both*
- **Separate Incompatibles**

4.3



Standard Laboratory Practices

Storage

Incompatibles (oxidizers)

- **React with:**
 - *organic chemicals, reducing agents, metals, hydrides, phosphorus, sulfur, carbon, ammonia*
- **Store solids together; liquids together**

4.3



Standard Laboratory Practices

Storage

Incompatibles (oxidizers)

- **Solids:**

- *Perchlorates, peroxides, dichromates, nitrates, picrates, permanganates*

- **Liquids:**

- *Nitric acid, perchloric acid, sulfuric acid, hydrogen peroxide, bromine*

4.3



Standard Laboratory Practices

Storage

Incompatibles (acids)

- **React with:**
 - *Bases, metals & their salts, hydrides, sulfides, azides, cyanides, nitrates, organic peroxides, oxidizing agents, water*
- **Store separately from other chemicals**
- **Separate organic acids & inorganic acids**

4.3



Standard Laboratory Practices

Storage

1) Separate

- *Flammables, oxidizers, acids, bases*

2) Separate

- *Organic & inorganic families*

3) Separate

- *Families into related compatible groups*

4) Then store alphabetically

4.3



Standard Laboratory Practices

Chemical Waste

Safe Procedures:

- ***Do Not pour chemicals down the drain!***
- ***Place waste in proper containers***
- ***Dispose of chemical waste according to facility and local guidelines***

4.3



Standard Laboratory Practices

Chemical Waste

Creative Waste Handling

- Use alternate (less hazardous) chemicals
- Minimize quantities used
- Recycle chemicals
- Reduce the hazard before disposal
 - *Distillation*
 - *Neutralization*
 - *Evaporation*

4.3



Emergency Response

Personal Exposure

- Don't panic
- Send for help
 - *If you feel you cannot handle*
 - *If you need a respirator*
- Assist any injured or contaminated personnel
 - *Injured persons are priority*
 - *Obtain medical attention*
- Notify supervisor

4.4



Emergency Response

Personal Exposure

Eyes

- Immediately flush w/ water for 15 min
- Assist or get assistance during flushing
- Hold or assist in holding eye lids open
- Move eyeball around during flushing
- Get medical attention

4.4



Emergency Response

Personal Exposure

Skin

- Flush immediately w/ flowing water no less than 15 min
- Remove jewelry in exposed area
- Wash w/ warm water & soap if no burn visible
- Check MSDS/other information for delayed effects
- Get medical attention

4.4



Emergency Response

Personal Exposure

Clothing

- Use safety shower
- Quickly remove contaminated clothing, shoes, jewelry
 - *Time is critical to prevent serious skin burns*
 - *Modesty must not delay removal of clothing; cut clothing off if necessary*
 - *Don't waste time wiping chemical from clothing or trying to neutralize it*

4.4



Emergency Response

Personal Exposure

Clothing (cont.)

- Be careful not to spread chemical from clothing to skin or eyes
- Flush contaminated areas w/ water for 15 min
- Get medical attention

4.4

Emergency Response

Environmental Exposure

- **Notify personnel**
- **Evacuate if necessary or unsure**
- **Control entry until spill cleaned up**
- **Call emergency response if necessary**
- **Call security to keep area clear & direct emergency response**



4.4



Emergency Response

Environmental Exposure

Spills

Use socks, pillows or booms for containment:

- ***Universal sorbent***
 - **Shredded polypropylene fill**
- ***Use for solvents, oils, caustics, acids****
- ***Do not use w/:***
 - **Fuming sulfuric acid, fuming nitric acid**
 - **Strong oxidizers**

4.4



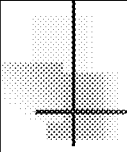
Emergency Response

Environmental Exposure

Solvents

- Use solvent absorbents
 - Solusorb
 - *Vermiculite, clay, sand, kitty litter, oil Dri, granular activated carbon*
- Use on common organics
- Do not use *Solusorb* for:
 - *Strong oxidizers, including peroxides*
 - *Highly reactive organics*

4.4



Emergency Response

Environmental Exposure

Solvents

- **Remove all ignition sources**
- **Provide maximum ventilation.**
- **Wear appropriate PPE**

4.4



Emergency Response

Environmental Exposure

Acids

- **Use acid neutralizers**
 - Neutrasorb
 - *Sodium carbonate or bicarbonate*
- **Use for common acids**
 - *Hydrochloric acid, perchloric acid, sulfuric acid, nitric acid, phosphoric acid, acetic acid*

4.4



Emergency Response

Environmental Exposure

Acids

- **Cautions for *Neutrasorb***
- **Do not use w/**
 - *Hydrofluoric acid, peroxy (per) organic acids, highly reactive chemicals*
- **Wear appropriate PPE.**

4.4



Emergency Response

Environmental Exposure

Caustics

- **Use caustic neutralizers**
 - **Neutrakit-2**
 - ***Sodium bisulfate, citric acid***
- **Wear appropriate PPE!**
- **Provide maximum ventilation**

4.4

Emergency Response

Environmental Exposure

Mercury

- **Wear protective gloves**
 - *Latex, PVC, nitrile*
- **Use *Hg Absorb* sponges & powder**
- **Use flask w/ aspirator for small spills**
- **Use Hg vacuum for larger spills**
- **Dispose of Hg waste properly**
 - *Keep in tightly closed containers*

4.4



Emergency Response

Environmental Exposure

Strong Oxidizers

- **Use inert absorbents**
 - *Sand, clay (cat litter), vermiculite*
- **Caution:**
 - *Absorbed chemical still hazardous*
- **Wear appropriate PPE**
- **Dispose of as hazardous material**

4.4